mal growth kept pace with the larvae, which are comparatively large for so small a mushroom. The hole traced out in *fig. 4* appears to represent the habit of the larva. It has been suggested that most gall insects produce hollow or chambered abnormal growths, and that this may not be a form which habitually produces galls. It is of course possible that the eggs were laid very early and that this stimulus produced a gall, whereas had they been laid later the mushroom would have been destroyed in the ordinary way. The argument that this is a true gall insect would be the size of the gall, and of the larva producing it ($5-6^{mm}$ at least). Larvae as large as these could not work in the ordinary Omphalia pileus because the flesh is too thin and would not offer sufficient food and protection, which is always sought by the insect in laying eggs. It is at least interesting to find such a gall in a group of plants where such a growth has not been reported in our literature. This note, perhaps will bring similar cases to light.—CHARLES THOM, *Cornell University, Ithaca, N. Y.*

SELECTED NOTES. II.—LIVERWORTS.

DUMORTIERA.—Although the genus Dumortiera has as a whole become greatly reduced in the structure of its gametophyte from the typical Marchantia form, and has, generally, hardly a trace left of the complex chambers and nutritive outgrowths characteristic of the group, there are certain species which show, normally or occasionally, enough resemblance to the typical form to leave no doubt that its simplicity is secondary, acquired through retrogressive development from more complex members of the Marchantiaceae. Of the several species of Dumortiera there is only one in which traces of dorsal chambers have been described. This is *D. irrigua* L., which was studied by Leitgeb[1] from herbarium material only. At the growing point on the upper surface he finds and figures quite distinct chambers, without, however, a very definite mouth opening. The upper covering of the chambers becomes broken and disappears more and more on the older part of the thallus, until finally only the basal parts of the chamber walls are left as reticulations on the surface. Leitgeb also mentions "kürzeren oder längeren Haarpapillen" which occasionally arise from the surface of the thallus and represent the cell rows which fill the air-chambers of Marchantia. Campbell (*Mosses and Ferns*) finds no trace of any such complexities on the thallus of *D. trichocephala* from the

[1] Untersuchungen über die Lebermoose, Heft 6, 1881.

Hawaiian Islands.[2] He says: "No indication of lacunae can be seen either near the apex or farther back, the whole thallus being composed of a perfectly continuous tissue without any intercellular spaces." Schiffner[3] describes two species of Dumortiera from Java, *D. trichocephala* and *D. velutina*. Of the first he says: "Frons oberseits ohne oder nur mit zerstreuten Papillen übersät." In neither species does he mention the presence of any trace of air chambers or reticulations. In the possession of numerous papillae on the upper surface *D. velutina* shows itself to be less reduced than *D. trichocephala*.

Z. Kamerling[4] gives a figure of *D. hirsuta* which shows the upper surface thickly covered with unicellular papillae. He refers to Leitgeb's work on *D. irrigua*, but does not mention finding any trace of chambers in *D. hirsuta*. My own observations on the last-mentioned species, which grows rather abundantly in two situations around Chapel Hill, bring out the presence in some cases of air chambers in the young parts of the thallus, which closely resemble those in *D. irrigua*.

Our species, like others of the genus, grows in wet, springy places where the water is constantly trickling through, and it evidently requires more moisture than any other members of the Marchantiaceae (with the exception of Riccia) that occur in this region. Z. Kamerling,[5] in his classification of the Marchantiaceae according to biological types, has considered Dumortiera with good reason as typically hygrophilous, and there seems little doubt that the loss of its air chambers is due to its semi-aquatic life.

The spot where Dumortiera is most abundant here is a gentle rocky slope on the north side of a well-wooded hill, where spring water is constantly oozing out and keeping the thalli saturated. Plants from this place show no air chambers. The other spot where Dumortiera has been found is under a series of overhanging rocks that have been hollowed out so as to form caves 8 to 12^{ft} deep. At the base of these caves the liverwort grows on the damp porous sand, where the water never seems to accumulate so as to cover the plants. Specimens from this situation can be plainly seen with the naked eye to be reticulated over the entire surface, as shown in *fig. 1*, which is from a

[2] See also CAMPBELL, The systematic position of the genus Monoclea. BOT. GAZ. 25: 272–274. 1898.

[3] Die Hepaticae der Flora von Buitenzorg. Leiden. 1900.

[4] Zur Biologie und Physiologie von Marchanticeen. Pp. 73, *pls. 4*. München, 1897.

[5] *Op. cit.* p. 38.

photograph. From sections made through the growing point it could be seen that in the younger parts the air chambers were about as perfect as in Marchantia. Such a chamber is shown in *fig. 2*. It will be noticed that the pore at the top is not so definite as in typical cases, but in every other way the chamber is perfect. There are several cells projecting from the floor, which contain chromatophores and are no doubt the homologues of the filaments filling the chambers of Marchantia, as remarked by Leitgeb. These papillae are not at all abundant, but are scattered here and there, and often persist in the older parts. They were never found to form chains of cells, as in more complex thalli. As they become further and further

FIG. 1.—*Dumortiera hirsuta*. Two thalli of natural size; from a photograph.

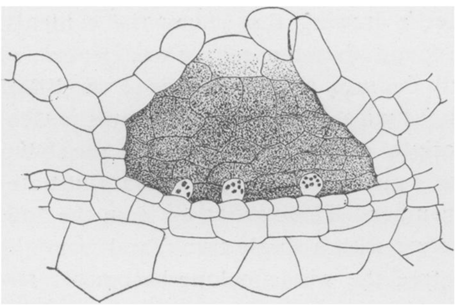

FIG. 2.—The same. Section through an air chamber. ×246.

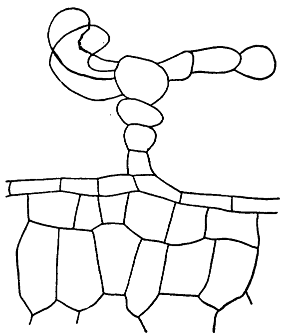

FIG. 3.—The same. Wall of chamber an older part with a few cover cells still attached. × 246.

removed from the growing point, the air chambers become less perfect, the roof cells become torn apart, and many are thrown off, until only a few remain around the upper edge of the wall cells (*fig. 3*). Finally, on the older parts, only the basal cells of the partition are left to form the reticulations seen in *fig. 1*.

It will be seen that we have in *D. hirsuta* chambers and papillae

which almost exactly resemble those found by Leitgeb in *D. irrigua.* They show beyond a doubt that the thallus of Dumortiera has been derived from more complex forms. It seems probable that the comparative darkness of the caves where the plants are found was the factor that induced the formation of the papillae, and that the absence of surface water was favorable to the development of the air chambers.

The "delicate appressed pubescence" mentioned by Underwood (Gray's *Manual of Botany*) as sometimes present on the upper surface of *D. hirsuta* is no doubt the remnants of the air chambers here described.

In his work on the mycorhiza of the Marchantiaceae N. Golenkin[6] could find no trace of fungus in Dumortiera, although he demonstrated it in Preissia, Marchantia sp., Fegatella, and others. I have looked carefully for mycorhiza in Dumortiera, but in no case was any found in the thallus cells. Fungus threads were often seen running up inside the rhizoids, but they were never traced into the living tissue. There is no difficulty in finding abundant mycorhiza in Fegatella.

BLASIA PUSILLA L.—The symbiotic relation of Blasia and Nostoc has often been noted, and Leitgeb (*op. cit.* Heft 1) has given a very good description of the structure and origin of the peculiar chambers of the Blasia thallus in which the Nostoc lives. He failed, however, to get a preparation showing a section of a fully developed chamber with contents, and does not give a drawing that shows the contents. By pressing out the Nostoc he found that the colony was penetrated by clear cells, which he correctly deduces to be branches of the Blasia thallus that have arisen from the slime-secreting hair that was present in the young stages. As the origin of the branched cells ramifying through the Nostoc is so peculiar, I give a drawing (*fig. 4*) that illustrates this point in a mature Nostoc chamber. There grows up from the floor of the chamber a tree-like structure with a single trunk, and from the repeated ramifications of this tree the whole colony becomes interwoven with cells which doubtless serve to abstract nourishment from the algae. This whole ramifying structure has in all probability come, as Leitgeb thought, from the subsequent growth of the slime-secreting cell shown in *fig. 5, s.*

This cell, in the young stage shown, projects upward into the "Blattohr," as Leitgeb calls it, while at the opening at the base on one side the Nostoc enters. This opening is soon closed, and as the cavity

[6] Die Mycorhizaähnlichen Bildungen der Marchantiaceen. Flora 90: 209–220, *pl. 11.* 1902.

grows larger and the Nostoc multiplies, the tree-like upgrowth is produced. In other cases of such symbiotic relationships, as Anthoceros, there are, likewise, cells growing in from the host plant; but in all such cases, so far as I know, these outgrowths originate, not from a common base, but separately and at many points. The striking and beautiful arrangement in Blasia seems to be confined to it alone.

SPHAEROCARPUS TERRESTRIS Smith.—I have found this liverwort abundantly at Chapel Hill, N. C., Selma, N. C., and Florence, S. C. Active spermatozoids were obtained in April of this year from Chapel Hill plants, and it is probable that they are liberated during the greater

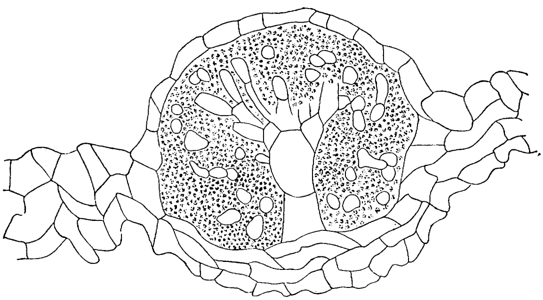

FIG. 4.—*Blasia pusilla.* Section of a large Nostoc chamber. × 166.

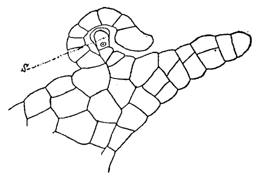

FIG. 5.—Section of a young chamber. × 250.

part of the growing season, as sporophytes of all ages can be found at almost any time.

It is the sterile cells of the sporangium, however, that I wish especially to mention. They are so peculiar in appearance and behavior as to deserve more attention than they seem to have received. These cells, though probably the homologues of the elaters of higher forms, do not bear the least resemblance to them. They are round, have clear cell walls, and contain a good number of bright green chlorophyll granules. These granules retain their bright color almost to the time of the ripening of the spore. They then fade slightly to a yellowish-green, but are still distinctly colored and not the least corroded when the spores are quite ripe. If a ripe black sporangium is crushed under the microscope, these green cells at once attract attention as being totally different from any other sterile cells in the sporangia of either liverworts or ferns. They no doubt carry on photosynthesis to the last moment.

An attempt was made to keep these sterile cells alive on wet filter

paper, in the hope that they might divide; but, although they remain green and intact for more than a week, a gradual fading set in and they finally died. Perhaps they would behave differently in nutrient solution, but I have not yet tried this. Leitgeb (*op. cit.*, Heft 4) also failed in his attempt to sprout these peculiar cells.

In conclusion I wish to express my hearty thanks to Professor Alexander W. Evans for the loan of valuable literature.— W. C. COKER, *University of North Carolina, Chapel Hill.*